1. (CLRS 7.2-2) What is the running time of QUICKSORT when all elements of array A have the same value?

2. (CLRS 7.2-3) Briefly sketch why the running time of QUICKSORT is $\Theta(n^2)$ when the array A contains distinct elements and is sorted in decreasing order.

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1Collaboration is allowed, even encouraged, provided that the names of the collaborators are listed along with the solutions. Write up the solutions on your own.
3. (CLRS 7-3) Professors Dewey, Cheatham, and Howe have proposed the following “elegant” sorting algorithm:

\[
\text{Stooge-Sort}(A, i, j) \\
\text{if } A[i] > A[j] \\
\quad \text{then exchange } A[i] \leftrightarrow A[j] \\
\text{if } i + 1 \geq j \\
\quad \text{then return} \\
\quad k \leftarrow \lfloor (j - i + 1)/3 \rfloor \\
\text{Stooge-Sort}(A, i, j - k) \\
\text{Stooge-Sort}(A, i + k, j) \\
\text{Stooge-Sort}(A, i, j - k)
\]

a. Argue that \(\text{Stooge-Sort}(A, 1, \text{length}[A])\) correctly sorts the input array \(A[1..n]\), where \(n = \text{length}[A]\).

b. Give a recurrence for the worst-case running time of \(\text{Stooge-Sort}\) and a tight asymptotic (\(\Theta\)-notation) bound on the worst-case running time.

c. Compare the worst-case running time of \(\text{Stooge-Sort}\) with that of insertion sort, merge sort, heapsort, sock sort, and quicksort. Do the professors deserve tenure?
4. (CLRS 8.3-2) Which of the following sorting algorithms are stable: insertion sort, merge sort, quicksort? Give a simple scheme that makes any sorting algorithm stable. How much additional time and space does your scheme entail?

5. (CLRS 8.3-4) Show how to sort $n$ integers in the range 1 to $n^2$ in $O(n)$ time.

6. (CLRS 8.4-1) Illustrate the operation of BUCKET-SORT on the array

$$A = [.79, .13, .16, .64, .39, .20, .89, .53, .71, .42]$$
7. (CLRS 8-2 first part only) You are given an array of integers, where different integers may have different numbers of digits, but the total number of digits over all the integers in the array is \( n \). (a) What is the worst-case running time of radix sort? Give an example of input that elicits this worst-case. (b) Show how to sort the array in \( O(n) \) time.